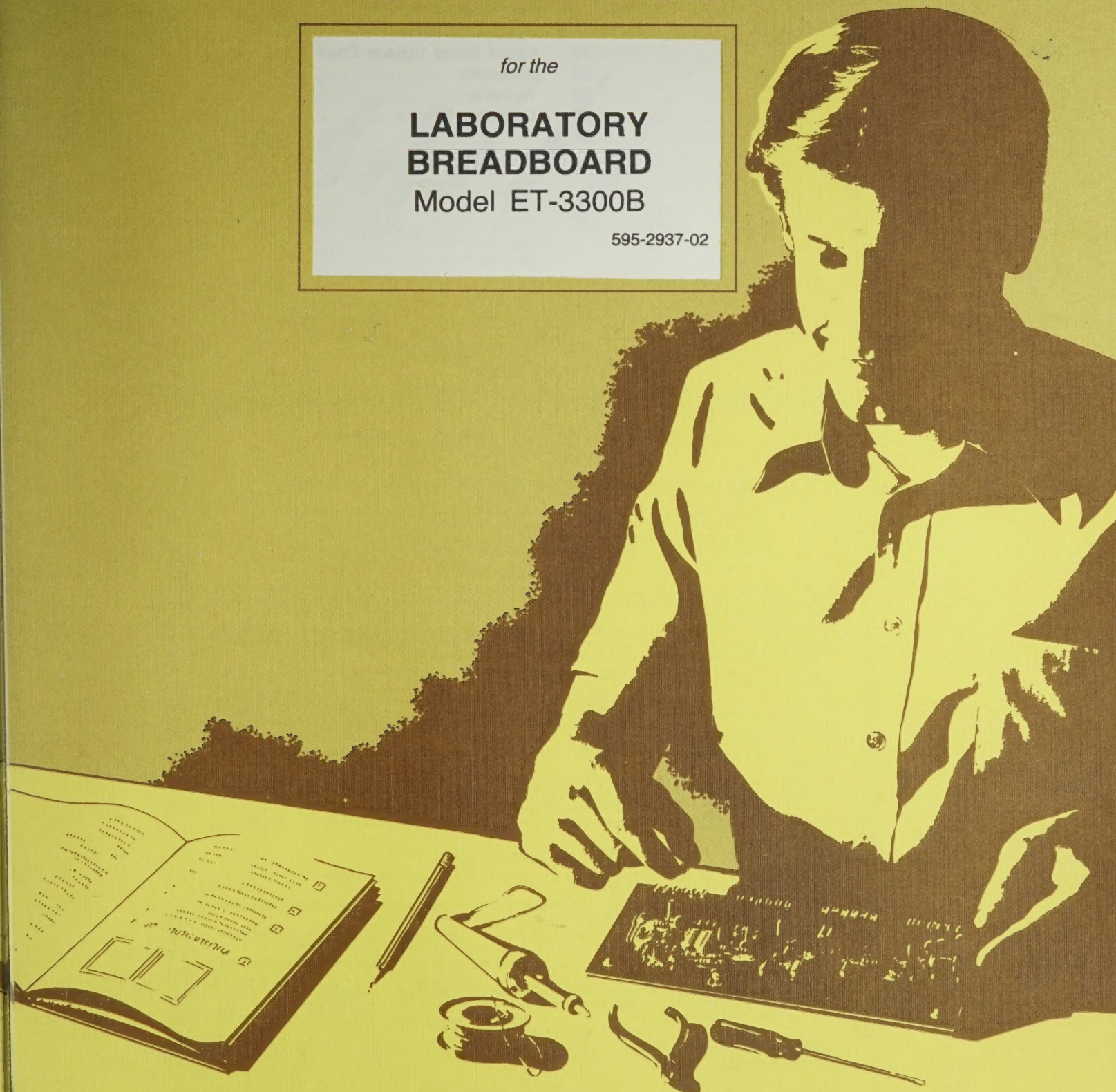


HEATHKIT[®] MANUAL

for the

**LABORATORY
BREADBOARD**
Model ET-3300B

595-2937-02



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers

8:00 A.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs (616) 982-3310
Amateur Radio (616) 982-3296
Test Equipment, Weather Instruments and
Home Clocks (616) 982-3315
Television (616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive,
Appliances and General Products (616) 982-3496
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Computers — Software:
Operating Systems, Languages, Utilities (616) 982-3860
Application Programs (616) 982-3884
Heath Craft Wood Works (616) 982-3423



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

LABORATORY BREADBOARD

Model ET-3300B

595-2937-02

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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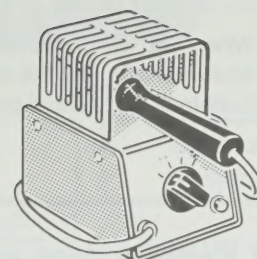
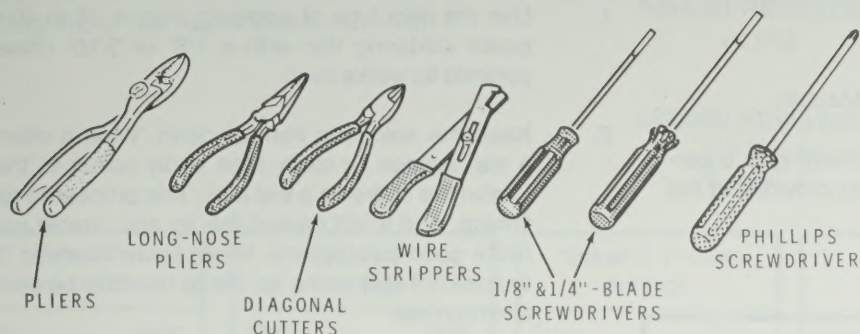
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ASSEMBLY NOTES

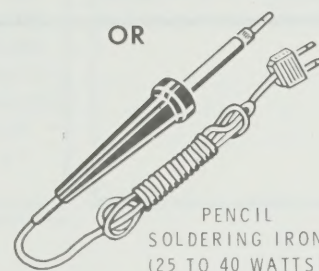
TOOLS

You will need these tools to assemble your kit.



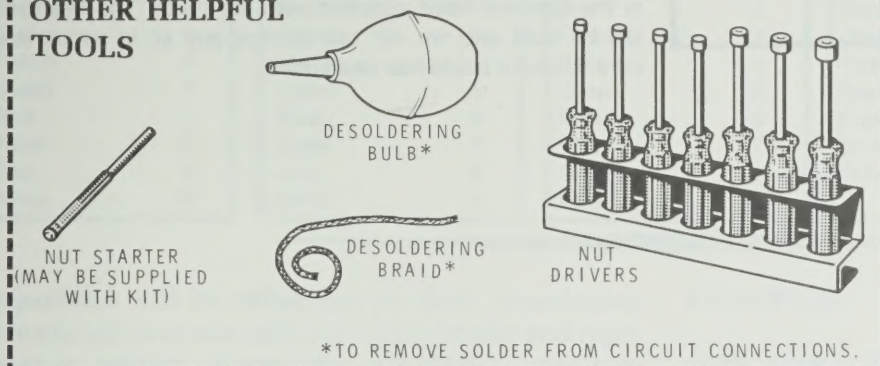
SOLDERING IRON

OR



PENCIL SOLDERING IRON
(25 TO 40 WATTS)

OTHER HELPFUL TOOLS



*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

- Follow the instructions carefully. Read the entire step before you perform each operation.
- The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
- Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
- Position all parts as shown in the Pictorials.
- Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:
- In the Parts List,
 - At the beginning of each step where a component is installed,
 - In some illustrations,
 - In the Schematic,
 - In the section at the rear of the Manual.
7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

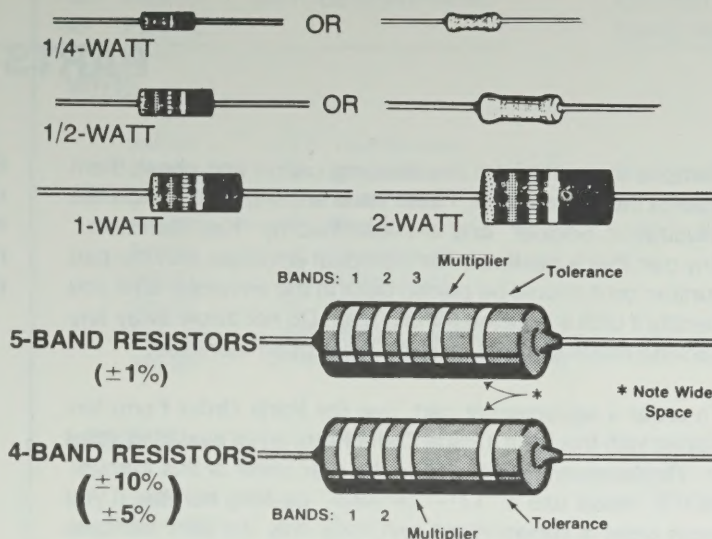
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 or 50:50 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), k Ω (kilohms), or M Ω (megohms). They are usually identified by a color code and four or five color bands, where each color represents a number. These colors (except for the last band, which indicates a resistor's "tolerance") will be given in the steps in their proper order. Therefore, the following color code is given for information only. NOTE: Occasionally, a "precision" or "power" resistor may have the value stamped on it.



Band 1 1st Digit		Band 2 2nd Digit		Band 3 (if used) 3rd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	0	Black	1	Silver	± 10%
Brown	1	Brown	1	Brown	1	Brown	10	Gold	± 5%
Red	2	Red	2	Red	2	Red	100	Brown	± 1%
Orange	3	Orange	3	Orange	3	Orange	1,000		
Yellow	4	Yellow	4	Yellow	4	Yellow	10,000		
Green	5	Green	5	Green	5	Green	100,000		
Blue	6	Blue	6	Blue	6	Blue	1,000,000		
Violet	7	Violet	7	Violet	7	Silver	0.01		
Gray	8	Gray	8	Gray	8	Gold	0.1		
White	9	White	9	White	9				

Capacitors will be called out by their capacitance value in μ F (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:

EXAMPLES:

$$151K = 15 \times 10 = 150 \text{ pF}$$

$$759 = 75 \times 0.1 = 7.5 \text{ pF}$$

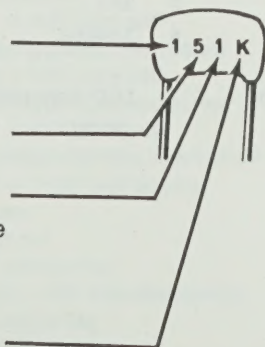
NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μ F).

First digit of capacitor's value: 1

Second digit of capacitor's value: 5

Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.

To find the tolerance of the capacitor, look up this letter in the Tolerance columns.



MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	± 1%
4	10,000	±2.0 pF	G	± 2%
5	100,000		H	± 3%
			J	± 5%
8	0.01		K	± 10%
9	0.1		M	± 20%

PARTS LIST

Remove the parts from the shipping carton and check them against the following list. These parts are shown in a separate "Illustration Booklet" and are identified by "Key Numbers." Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not throw away any packing materials until all parts have been identified.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. NOTE: Never use a "171-" or "172-" packing number if you must order a replacement part. Use only the part numbers listed in the Manual Parts List for this purpose. For price information, refer to the separate "Heath Parts Price List".

Each circuit part has its own component number (R1, C3, Q2, etc.). Use these numbers when you want to positively identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List.
- At the beginning of each step where a component is installed.
- In some illustrations.
- In the Schematic.
- In the sections at the rear of the Manual.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

1/4-Watt Resistors

NOTE: The following resistors have a 5% tolerance (gold fourth color band) unless otherwise noted. 1% resistors have brown fifth color band.

A1	6-399-12	2	3.9 Ω , (orange-white-gold)	R4, R11
A1	6-221-12	1	220 Ω (red-red-brown)	R5
A1	6-511-12	2	510 Ω , (green-brown-brown)	R2, R8
A1	6-821	1	820 Ω , 1/2 watt (gray-red-brown)	R1
A1	6-102-12	2	1000 Ω (brown-black-red)	R3, R9
A1	6-272-12	1	2700 Ω (red-violet-red)	R7
A1	6-2001-12	1	2000 Ω , 1% (red-black-black-brown)	R12
A1	6-2251-12	1	2250 Ω , 1% (red-red-green-brown)	R13

Control

A2	10-382	1	2000 Ω (2 k)	R6
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

CAPACITORS

B1	21-75	2	100 pF ceramic	C9, C10
B1	21-163	2	0.001 μ F (1000 pF) ceramic	C4, C7
B2	25-865	3	10 μ F electrolytic	C3, C5, C8
B3	25-876	2	1000 μ F electrolytic	C2, C6
	25-272	1	6000 μ F electrolytic	C1
B4	25-200	1	.68 μ F tantalum	C11

DIODES

C1	56-97	1	1N301785 7.5V zener	ZD1
C1	57-42	2	3A1	D1, D2
C1	57-65	4	1N4002	D3, D4, D5, D6
C2	412-640	1	LED (light-emitting diode)	D7

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

TRANSISTORS — INTEGRATED CIRCUIT

NOTE: Transistor and integrated circuits are marked for identification in one of the following four ways:

1. Part number.
2. Type number. (On integrated circuits this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

D1	417-235	3	2N4121	Q5, Q7, Q8
D1	417-801	3	MPSA20	Q1, Q3, Q4
D2	417-852	1	TIP31	Q2
D2	417-872	1	TIP32	Q6
D3	442-30	1	UA309	IC1

HARDWARE

NOTE: The hardware may be in more than one packet. Open all the hardware packets before you check the hardware against the Parts List.

E1	250-163	18	#4 × 5/16" self-tapping tapping screw
E2	250-1420	1	6-32 × 3/8" black flat phillips head screw
E3	250-1280	6	6-32 × 3/8" black phillips head screw
E4	250-1425	2	6-32 × 1/2" black phillips head screw
E5	250-1434	9	#6 × 3/8" black self-tapping phillips head screw
E6	250-1435	1	#6 × 1/2" black self-tapping phillips head screw
E7	250-1460	8	#6 × 5/8" black self-tapping flat phillips head screw
E8	250-1137	2	#6 × 1-1/8" self-tapping screw
E9	252-3	3	6-32 nut
E10	254-1	6	#6 lockwasher
E11	255-142	2	6-32 × 5/8" threaded spacer
E12	259-1	1	#6 solder lug
E13	253-9	1	#8 flat washer

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

WIRE

344-21	2-1/2'	Red stranded
344-50	3'	Black solid
344-51	3'	Brown solid
344-52	3'	Red solid
344-53	3'	Orange solid
344-54	3'	Yellow solid
344-55	3'	Green solid
344-155	16"	Green stranded
346-35	2-1/2"	Heat shrinkable sleeving

LABELS

390-1916	1	Caution
390-2365	1	Trim
	1	Blue and white

TERMINAL STRIP — SOCKETS

F1	431-10	1	3-lug terminal strip
F2	432-874	5	Small wire socket
F3	432-875	4	Breadboarding socket (with loose connectors)
F4	432-913	3	Wire bus socket
F5	434-210	1	Transistor socket

MISCELLANEOUS

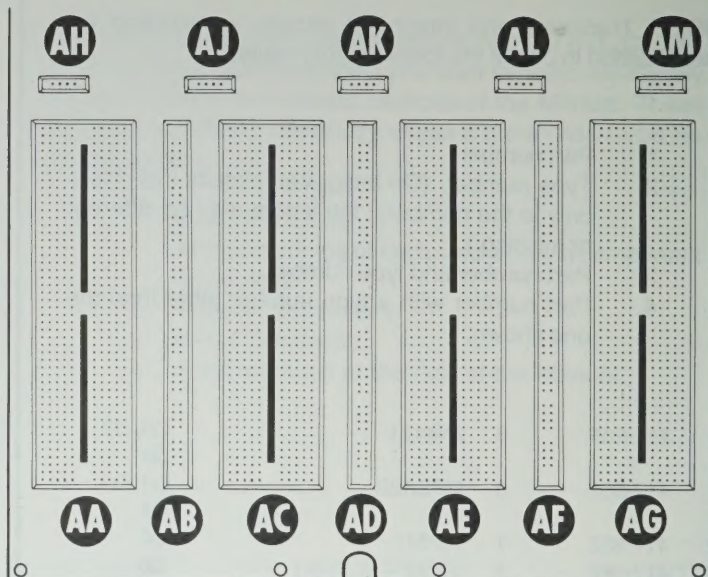
	54-990	1	Power transformer	T1
	60-607	1	Rocker switch	SW1
	73-92	1	5" foam gasket	
G1	75-52	1	Switch insulator	
G2	75-724	1	Insulator plate	
G3	75-29	1	Strain relief	
	75-809	1	Insulator paper	
	85-2573-3	1	Circuit board	
	89-54	1	Line cord	
G4	92-775	1	Cabinet top	
G5	92-776	1	Cabinet bottom	
G6	204-2539	1	Relief plate	
G7	215-609	1	Heat sink	
G8	261-28	4	Plastic foot	
G9	352-13	1	Silicone grease	
G10	260-700	1	LED grommet	
G11	421-42	1	3/8-ampere slow-blow fuse	F1
G12	423-11	1	Fuseholder	
G13	490-5	1	Nut starter	
G14	490-111	1	IC puller	
G15	207-3	1	Cable clamp	
	597-260	1	Parts Order Form	
		1	Manual (see front cover for part number.)	
			Solder	

STEP-BY-STEP ASSEMBLY

ASSEMBLY NOTES

1. Before you start to assemble this kit, be sure you read the wiring, soldering, and step-by-step assembly information in the "Kit Builders Guide."
2. Follow the Manual instructions carefully and read the entire step before you perform the operation. Position all parts as shown in the illustrations. These illustrations are called pictorials and details. Pictorials show the overall operation for a group of assembly steps; details generally illustrate a single step. When you are directed to refer to a certain pictorial "for the following steps," continue to use that pictorial until you are referred to another pictorial for another group of steps.
3. Resistors will be called out by their resistance value in Ω or $k\Omega$, and their color code (if they are color coded).
4. Capacitors will be called out by their capacitance value in μF and their type (ceramic or electrolytic).

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so the ends cannot fly toward your eyes.

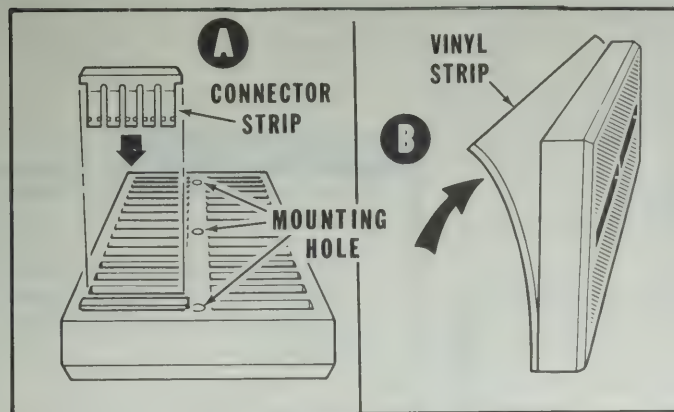


PICTORIAL 1

CIRCUIT BOARD

Refer to Pictorial 1 for the following steps.

- () Locate a set of breadboarding socket parts. Then refer to Part A of Detail 1A and install the connector strips, supplied with the breadboarding socket, into the socket. You may have some connector strips left over. Save them as spares.



Detail 1A

- () Locate the vinyl strip supplied with the breadboarding socket. Although you may have received two vinyl strips, only one will be used.
- () Check the breadboarding socket and make sure the connector strips are inserted as far as they can go.

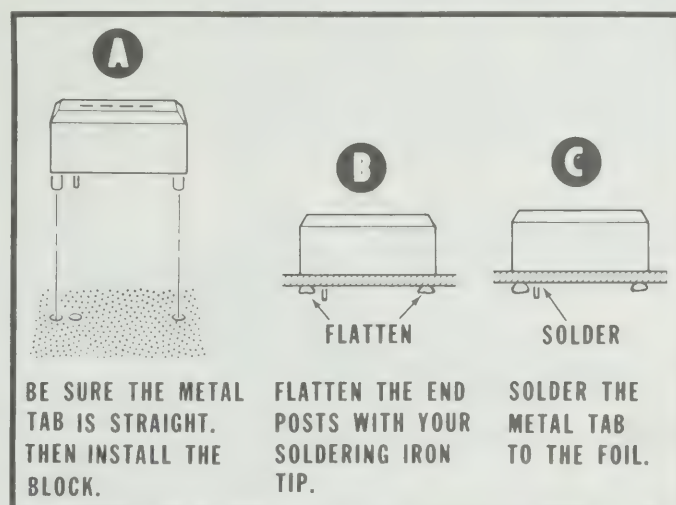
NOTE: When you install a vinyl strip on a breadboarding socket, you will cover the three socket mounting holes. Note the location of these holes.

- () Refer to Part B of Detail 1A and remove the paper backing from the vinyl strip supplied with the breadboarding socket. Then line up the long edges of the vinyl strip and socket as shown and press the sticky side of the strip against the socket.
- () With a blunt tool, press the vinyl down so that it sticks to the socket area between adjacent connectors.
- () In a like manner, prepare three more breadboarding sockets.
- () Position the circuit board as shown, with the painted side up. Only a portion of the circuit board is shown.
- () Punch three holes through the vinyl strip of a breadboard socket at the mounting screw holes. Then mount the socket onto the painted side of the circuit board at location AA with three #4 x 5/16" self-tapping screws.

- () In a like manner, mount breadboard sockets at locations AC, and AE.
- () In a like manner, mount a breadboard socket at AG, but only secure the socket at each end. The center screw will be installed in a later step.
- () Locate a wire bus socket and mount it onto the painted side of the circuit board at location AF with two #4 x 5/16" self-tapping screws. Do not remove the paper backing on the socket.
- () In a like manner, mount wire bus sockets at locations AD and AB.

NOTE: In the following step, you will solder to large areas of foil. Make sure you use enough heat on these connections. Hold the soldering iron against the connection and foil until the solder flows smoothly onto the foil.

- () Refer to Detail 1B and install small wire sockets at locations AH, AJ, AK, AL, and AM.



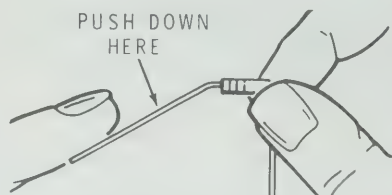
Detail 1B

START ➡

In the following steps, you will be given detailed instructions on how to install and solder the first resistor on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

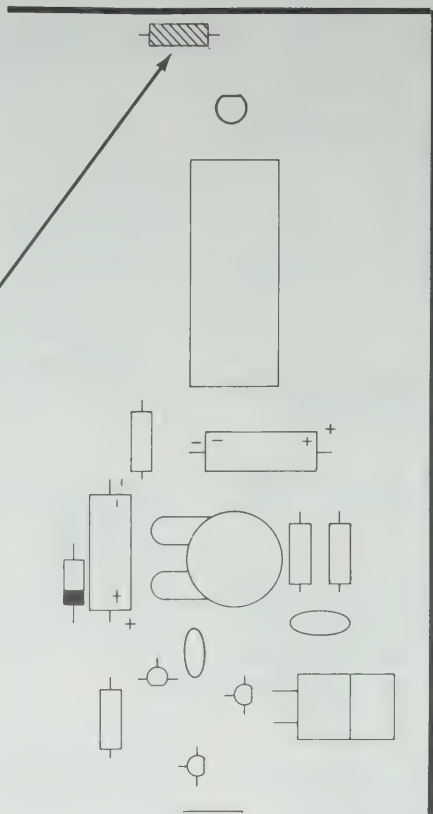
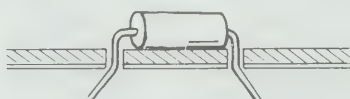
- () Position the circuit board as shown with the printed side (not the foil side) up.

- () R1: 820 Ω , 1/2-watt (gray-red-brown) resistor by the body. Position the printed value up and bend the leads straight down, as shown.



- () Push the leads through the holes at the indicated location on the circuit board.

- () Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.

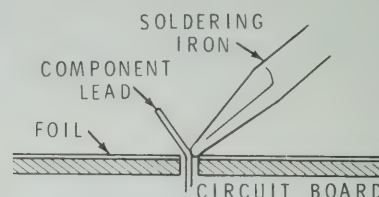


PICTORIAL 2

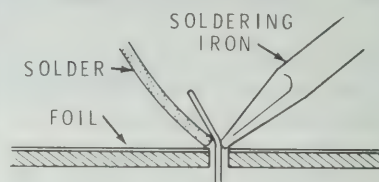
CONTINUE ➡

- () Solder the resistor leads to the circuit board as follows.

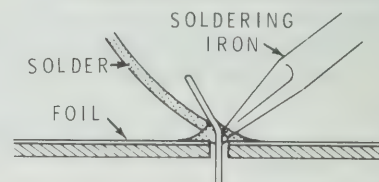
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. **IMPORTANT:** Let the heated lead and the circuit board foil melt the solder.



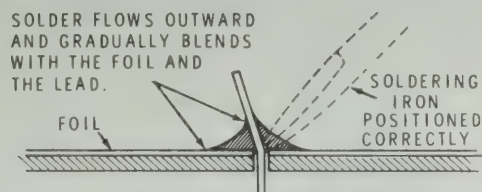
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



- () Cut off the excess lead lengths close to the connection. **WARNING:** Clip the leads so the ends will not fly toward your eyes.

- () Check each connection. Compare it to the illustrations on Page 0. After you have checked the solder connections, proceed with the assembly on Page 10. Use the same soldering procedure for each connection.

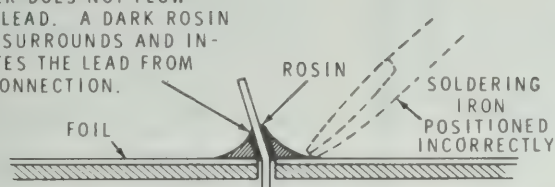
A GOOD SOLDER CONNECTION



When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

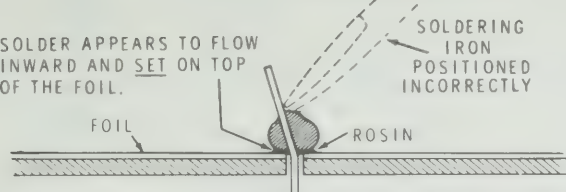
POOR SOLDER CONNECTIONS

SOLDER DOES NOT FLOW ONTO LEAD. A DARK ROSIN BEAD SURROUNDS AND INSULATES THE LEAD FROM THE CONNECTION.



When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER APPEARS TO FLOW INWARD AND SET ON TOP OF THE FOIL.

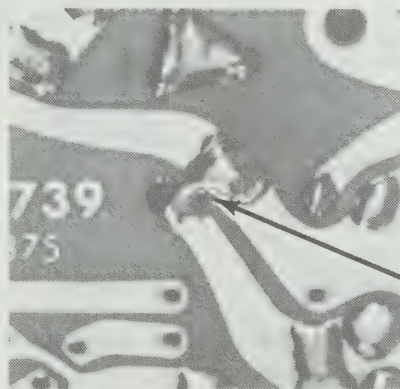


When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

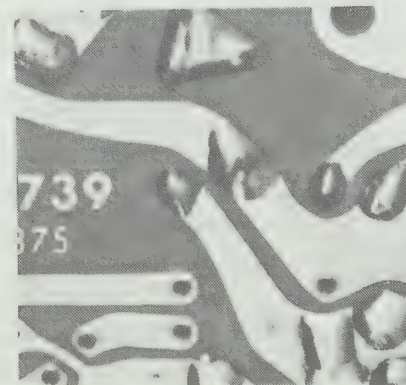
A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



A

SOLDER BRIDGE



B

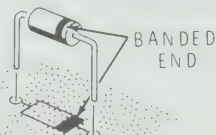
START

NOTE: Make sure you installed resistor R1 on Pictorial 2 before you continue.

- () Position the circuit board with the lettered side up and the wire sockets to the left. NOTE: Only a portion of the circuit board is shown in each Pictorial.

Install the circuit components as instructed in the steps that follow. Do not solder the leads until you are told to do so.

NOTE: When you install a diode, always match the banded end of the diode with the band mark on the circuit board. Refer to Detail 3A to identify the banded end.



- () ZD1: 1N301785, 7.5-volt zener diode (#56-97).

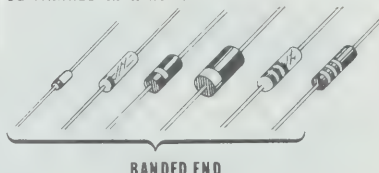
- () R6: 2000 Ω (2k) control (#10-382). Solder all four lugs to the foil at this time.

- () R5: 220 Ω (red-red-brown) resistor.

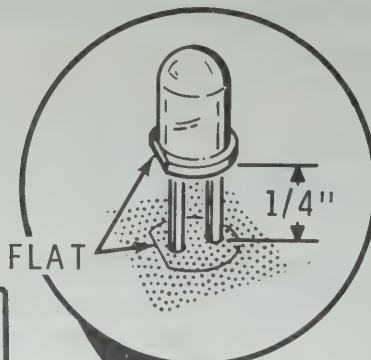
- () R4: 3.9 Ω (orange-white-gold) resistor.

- () Solder the leads to the foil and cut off the excess lead lengths.

IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



Detail 3A

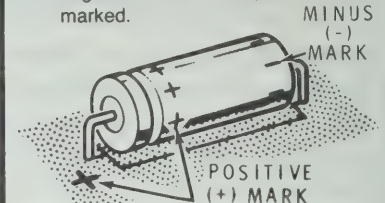
**CONTINUE**

- () D7: LED (#412-640). Position the flat of the LED with the flat on the circuit board. Be sure the LED is 1/4" above the board and then solder the leads to the foil and cut off the excess lead lengths.

- () R7: 2700 Ω (red-violet-red) resistor.

NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a plus (+) mark or a minus (-) mark near it. **Be sure** to install the positive lead in the positive-marked hole. Be careful; only the negative lead may be marked.

- () C3: 10 μ F electrolytic capacitor. Match the positive (+) end of the capacitor with the positive (+) mark on the circuit board. Be careful; only the negative end of the capacitor may be marked.



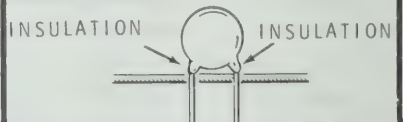
- () C5: 10 μ F electrolytic capacitor.

- () R2: 510 Ω (green-brown-brown) resistor.

- () R3: 1000 Ω (brown-black-red) resistor.

- () C4: .001 μ F (1000 pF) ceramic capacitor.

NOTE: When you install ceramic capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



- () C9: 100 pF ceramic capacitor.

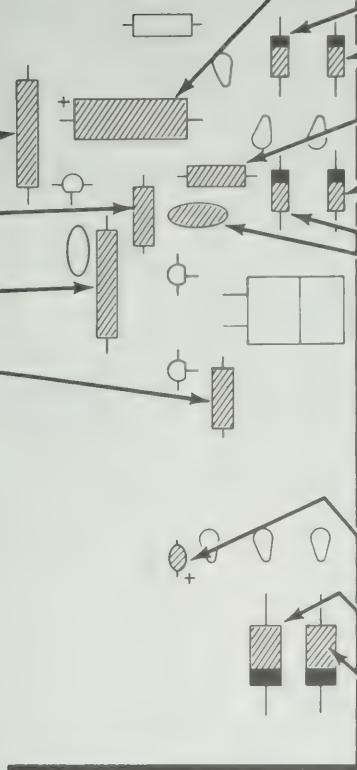
- () C10: 100 pF ceramic capacitor.

- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 3

START

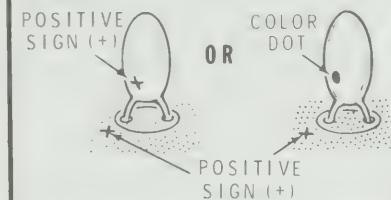
- () R13: 2250 Ω , 1% (red-red-green-brown).
- () R9: 1000 Ω (brown-black-red) resistor.
- () R12: 2000 Ω , 1% (red-black-black-brown).
- () R11: 3.9 Ω (orange-white-gold) resistor.
- () Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

- () C8: 10 μ F electrolytic capacitor.
- () D6: 1N4002 diode (#57-65).
- () D5: 1N4002 diode (#57-65).
- () R8: 510 Ω (green-brown-brown) resistor.
- () D3: 1N4002 diode (#57-65).
- () D4: 1N4002 diode (#57-65).
- () C7: .001 μ F (1000 pF) ceramic capacitor.

NOTE: When you install a tantalum electrolytic capacitor, always match the positive (+) or dot marked lead of the capacitor with the positive (+) marked hole on the circuit board.

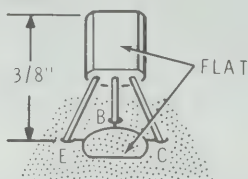


- () C11: .68 μ F tantalum capacitor.
- () D2: 3A1 diode (#57-42).
- () D1: 3A1 diode (#57-42).
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4

START ➡

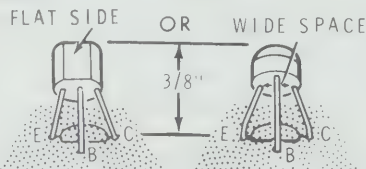
NOTE: Install the following transistors in the manner shown. First bend the center lead away from the flat, and line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes which are indicated by E, B, and C on the circuit board. Solder each lead to the foil and cut off the excess lead length. Position each transistor so its top is no more than 3/8" from the circuit board.



Install three MPSA20 transistors (#417-801) as follows:

- () Q4
- () Q1
- () Q3

NOTE: Install the following transistors in the manner shown. First bend the center lead toward the flat, and line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes which are indicated by E, B, and C on the circuit board. Solder each lead to the foil and cut off the excess lead length. NOTE: To install the round transistors, position the wide space as shown. It is not necessary to bend the leads.



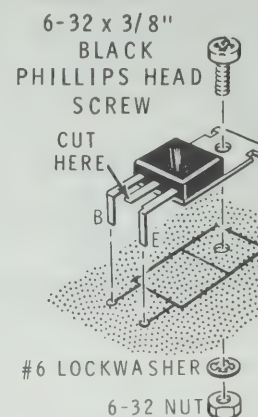
Install three 2N4121 transistors (#417-235) as follows:

- () Q8
- () Q5
- () Q7

CONTINUE ➡

Prepare and install the next two transistors as follows:

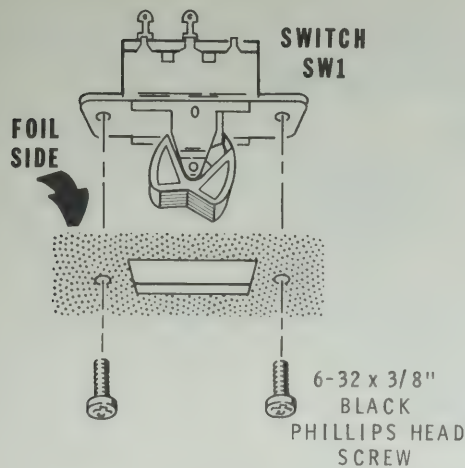
1. Position a transistor as shown, with the metallic side down. Then cut off the center lead.
2. Bend the other two leads down at the point where the lead size becomes small. NOTE: Hold the large lead portion with needle nose pliers so the leads cannot distort the case.
3. Insert the leads into the circuit board holes and secure the case to the circuit board with 6-32 x 3/8" black philips head screw, #6 lockwasher, and 6-32 nut. Do not overtighten the nut.
4. Solder the leads to the foil and cut off the excess lead lengths.



() Q2: TIP31 transistor (#417-852).

() Q6: TIP32 transistor (#417-872).

PICTORIAL 5



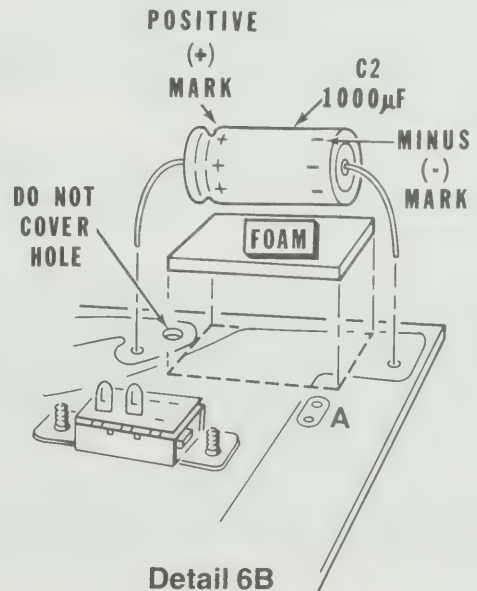
Detail 6A

Refer to Pictorial 6 (Illustration Booklet, Page 2) for the following steps.

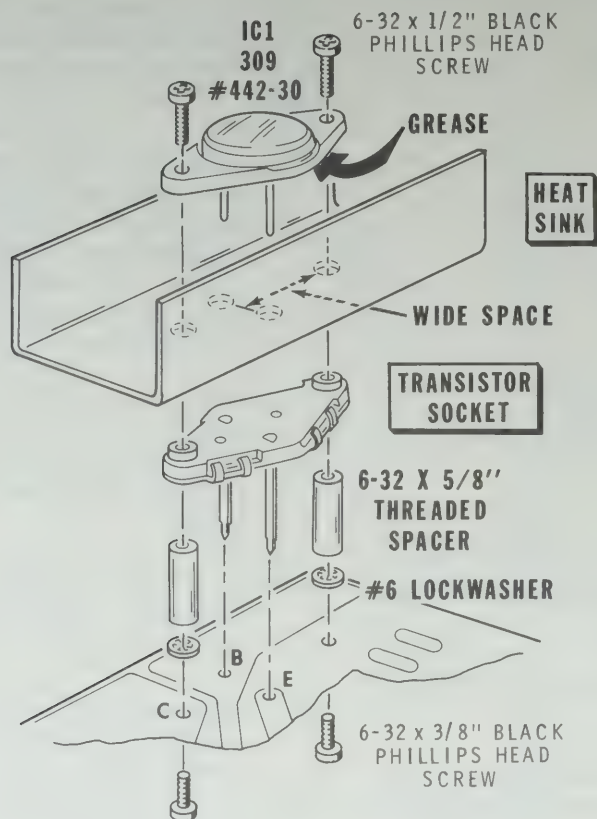
- (\) Position the circuit board as shown, with the foil side up.
- (\) Carefully examine the foil and make sure there are no solder bridges or leads touching adjacent foil patterns.
- (\) SW1: Refer to Detail 6A and mount the rocker switch at location SW1 with two 6-32 \times 3/8" black phillips head screws. Make sure the switch lugs are positioned properly.
- () Cut two 1-1/2" lengths from the 5" length of foam gasket. Save the remaining 2" length.
- () Refer to Detail 6B, remove the backing from one side of a 1-1/2" length of foam gasket, and press the sticky side to the foil side of the circuit board at C2. Then remove the backing from the other side of the gasket. Be careful not to cover hole "A" on the circuit board.

NOTE: In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-3), means to solder the connection. The number following the "S-" tells how many wires are at the connection.

- (\) C2: Mount a 1000 μ F electrolytic capacitor at C2 (on the foam gasket) with the positive lead in hole P (S-1) and the other lead in hole R (S-1). Be sure to position the capacitor near hole R so the large hole near P is not covered (a screw will be installed in this hole later). Cut off the excess lead lengths from the top of the circuit board (painted side).
- () C6: In a like manner, mount another 1000 μ F electrolytic capacitor and a 1-1/2" length of foam gasket at C6. Insert the positive lead through hole T (S-1), and the other lead through hole S (S-1). Cut off the excess lead lengths.
- () Install a #4 \times 5/16" self-tapping screw and a #6 solder lug at hole N. Position the solder lug as shown. Then solder the lug to the foil.
- () Remove the backing from the 2" length of foam gasket, and press the gasket to the circuit board at C1. Center it between the two mounting screws as shown.
- () C1: Mount the 600 μ F capacitor onto the foam gasket, insert the lead from the positive end into hole M (S-1), and connect the other lead to the solder lug at N (NS). Be sure the positive lead is 1-1/4" long as shown in the Pictorial. Cut off the excess lead lengths.



Detail 6B



Detail 6C

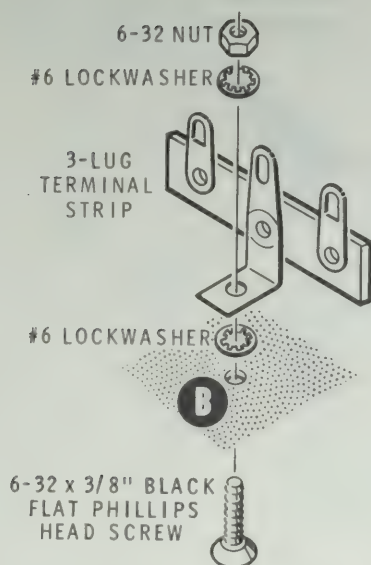
Refer to Detail 6C and mount the integrated circuit/heat sink assembly to the circuit board as follows:

- () Loosely install two 6-32 x 5/8" threaded spacers (on the foil side) with two 6-32 x 3/8" black phillips head screws and #6 lockwashers at IC1.
- () Cut open the silicone grease container and apply a thin layer of grease on the "UA309" integrated circuit (#442-30) as shown.
- () Position the heat sink and transistor socket as shown and press the integrated circuit leads into the socket. Note the wide space between the leads and mounting hole. Make sure the ridge around each socket mounting hole fits into the heat sink holes and that the socket is flush with the heat sink.
- () Insert the two socket lugs into holes B and E of the circuit board. (These holes are not marked on the circuit board.)

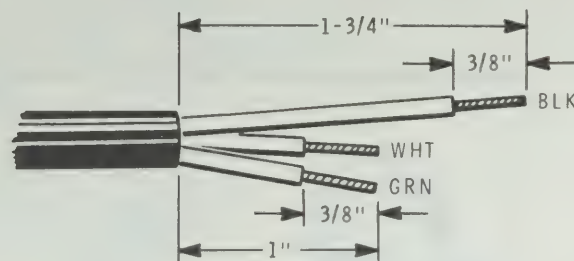
- () Loosely secure the heat sink assembly to the threaded spacers with two 6-32 x 1/2" black phillips head screws.
- () Tighten the two 6-32 x 3/8" black phillips head screws (through the circuit board). Then tighten the two 6-32 x 1/2" screws.
- () Solder the two socket lugs to the foil.
- () Prepare a 12" green stranded wire, and connect one end solder lug N (S-2). You will connect the other end later.

Temporarily set the circuit board aside.

CHASSIS ASSEMBLY AND WIRING



Detail 7A

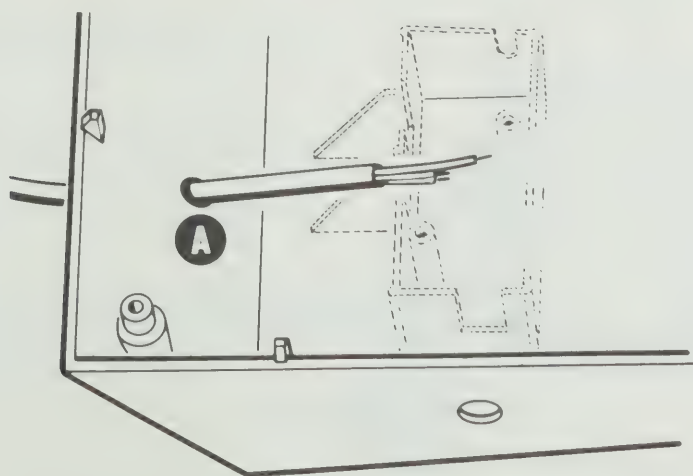


Detail 7B

Refer to Pictorial 7 (Illustration Booklet, Page 2) for the following steps. Only part of the bottom cabinet will be shown.

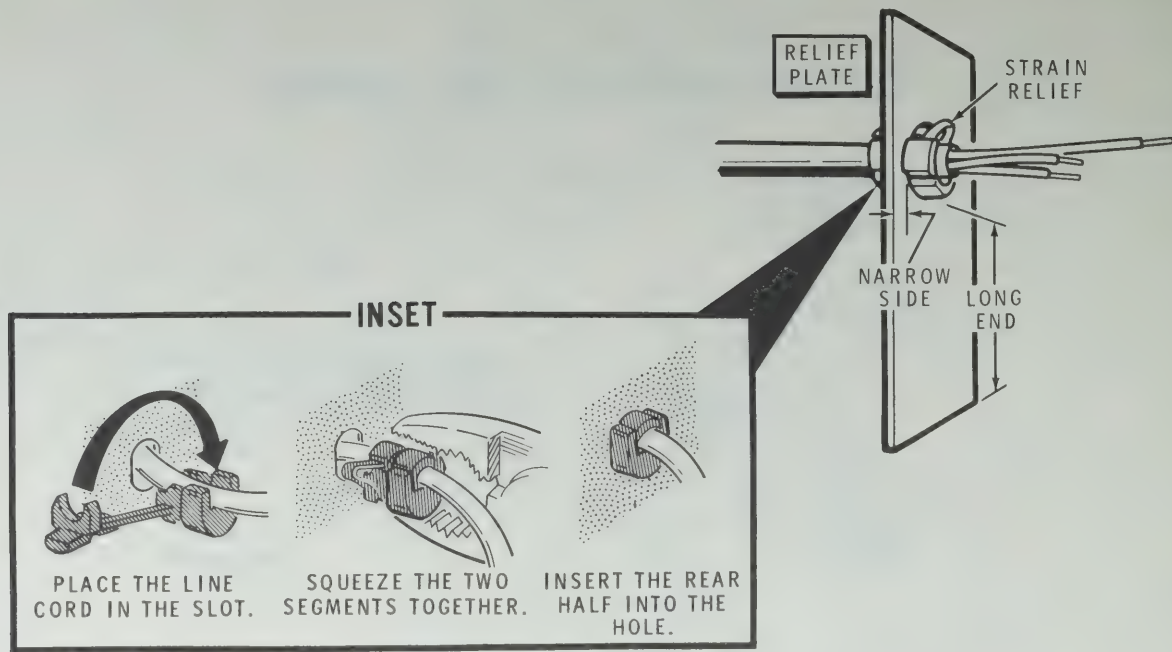
- () Refer to Detail 7A and mount the 3-lug terminal strip at B in the cabinet bottom as shown. Use a 6-32 x 3/8" black flat Phillips head screw, two #6 lockwashers, and a 6-32 nut.
- () Refer to Detail 7B and carefully remove the outer insulation from the end of the line cord opposite the plug as shown.

- () Again refer to Detail 7B and prepare this end of the line cord as shown.
- () Tightly twist the bare wire ends and apply a small amount of solder to the ends to hold the small strands together.
- () Refer to Detail 7C and push the end of the line cord through hole A (from the outside of the cabinet bottom).



Detail 7C





Detail 7D

- () Refer to Detail 7D, position the relief plate with the long end and narrow side as shown, insert the end of the line cord through the plate, and install the strain relief on the line cord as shown in the inset drawing.

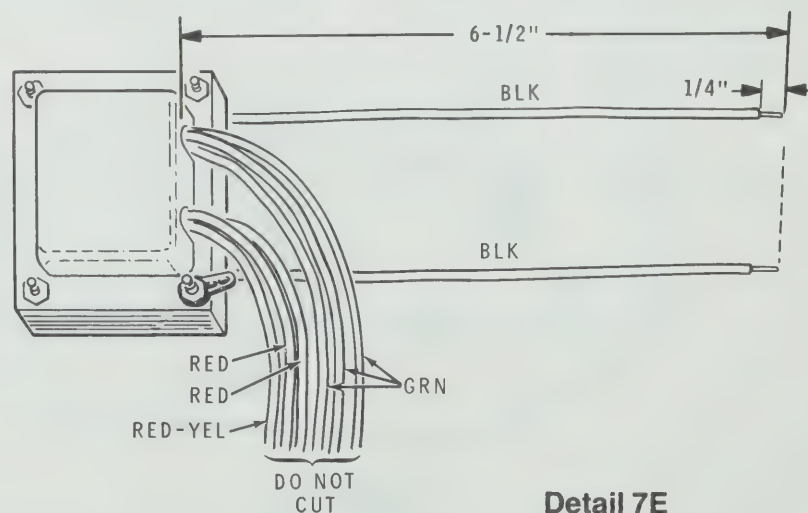
NOTE: In the following steps, be sure to make mechanically secure connections. Wrap the lead ends securely around the lugs.

- () Connect the white line cord lead to terminal strip B lug 1 (NS).
- () Connect the green line cord lead to terminal strip B lug 2 (NS).

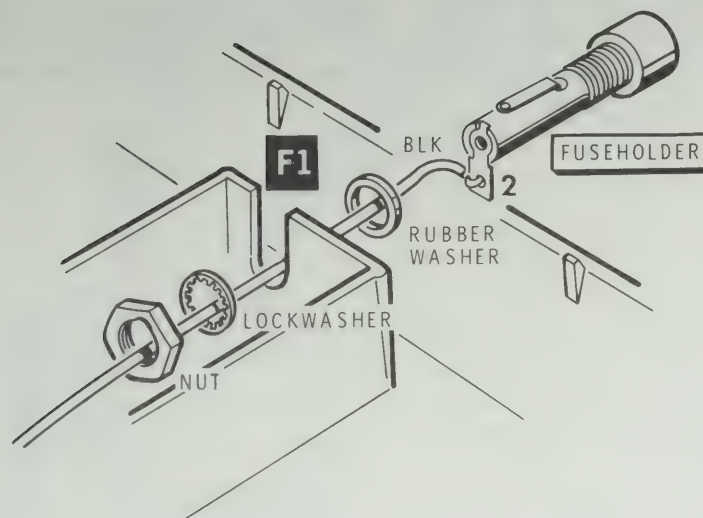
- () T1: Refer to Pictorial 7 and install the power transformer (with the red and green leads up) as shown. Use two #6 \times 1-1/8" self-tapping screws.

- () Refer to Detail 7E and prepare the transformer leads as shown. Measure the leads from where they come out of the transformer. Twist the bare ends and apply a small amount of solder to them, if necessary.

- () Slide the line cord relief plate into place. Be sure it is up against the wall of the box.



Detail 7E



Detail 7F

() Refer to Detail 7F and slide the rubber washer, lockwasher, and nut onto the fuseholder. Then position the fuseholder near the line cord and connect the black line cord lead to lug 2 of the fuseholder (S-1). Be sure to connect the wire to the side of the lug as shown.

() F1: Remove the fuseholder cap by twisting it counterclockwise with a screwdriver. Then install the 3/8-ampere, slow-blow fuse and replace the cap. Do not overtighten the cap.

() Again refer to Detail 6F and mount the fuseholder at F1 as shown.

NOTE: When you are instructed to prepare a wire, cut the wire to the indicated length and remove 3/8" of the insulation from each end.

In the following steps, you will make connections to terminal strip B. Wrap the lead ends tightly at the connections. Connect two of the power transformer leads as follows:

() Either black lead to lug 3 (NS).

() Other black lead to lug 1 (S-2).

() Prepare two 12" red **stranded** wires. Do NOT use the 3' red **solid** wire.

Connect one end of each 12" red stranded wire as follows:

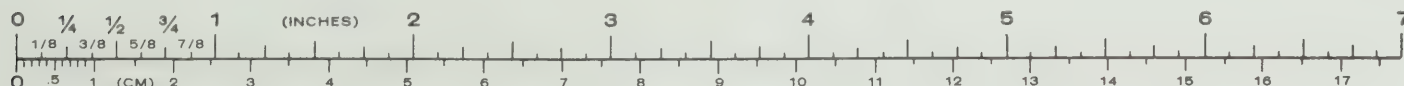
() 12" red stranded wire to lug 3 (S-2).

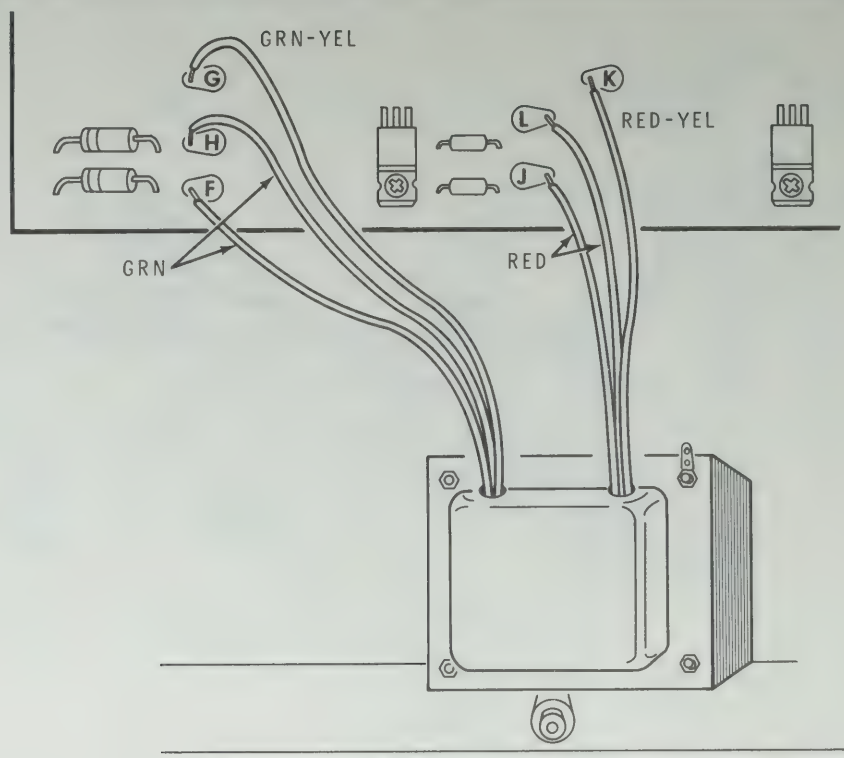
() 12" red stranded wire to fuseholder F1 lug 1 (S-1).

() Prepare a 4" green stranded wire.

() Connect one end of the green wire to terminal strip B lug 2 (S-2). Connect the other end of the wire to the solder lug at transformer T1 (NS).

() Connect the free end of the 12" green stranded wire coming from solder lug N to the solder lug at transformer T1 (S-2).





PICTORIAL 8

Refer to Pictorial 8 for the following steps.

- (\) Swing the circuit board up over the cabinet bottom so the circuit board is positioned as shown with the painted side up.

Connect the remaining transformer leads to the component side of the circuit board as follows:

- (\) Either red lead to hole J (S-1).
- (\) Other red lead to hole L (S-1).
- (\) Red-yellow lead to hole K (S-1).
- (\) Either green lead to hole F (S-1).
- (\) Other green lead to hole H (S-1).
- (\) Green-yellow lead to hole G (S-1).
- (\) Turn the circuit board over as shown in Pictorial 7.
- (\) Install the switch insulator over the lugs of rocker switch SW1.

- (\) Cut two 1" pieces of heat-shrinkable sleeving for use in the following step.

- (\) Slide a piece of the sleeving over each of the red wires coming from switch SW1.

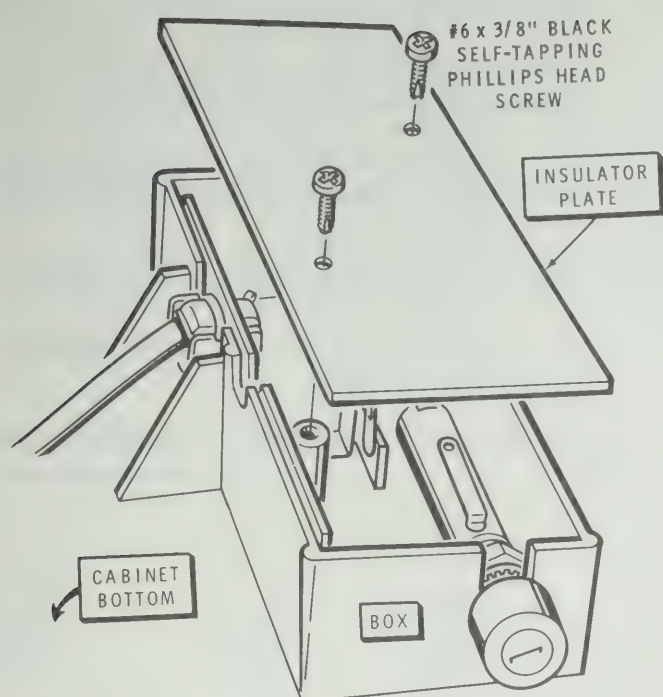
In the following steps, refer to Pictorial 7 and connect the free ends of the remaining red wires to switch SW1 as follows:

- (\) Red wire coming from fuseholder F1 to lug 1 (S-1).
- (\) Red wire coming from terminal strip B lug 3 to lug 2 (S-1).
- (\) Push the heat-shrinkable sleeving on the red wires over the switch lugs and shrink it in place with a lighter or a match as shown in the inset drawing. Do not use too much heat, or you will split the sleeving.
- (\) Connect the free end of the 4" green wire to the solder lug of transformer T1 (S-1).

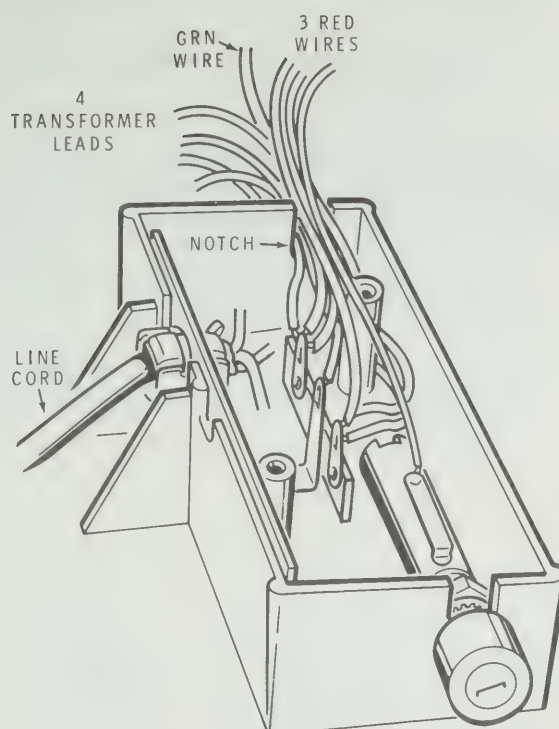
Refer to Pictorial 9 for the following steps.

- () Refer to Detail 9A and route the wires as shown.
- () Mount the insulator plate to the terminal strip box with two #6 × 3/8" black self-tapping phillips head screws. Do not pinch any wires between the plate and box.

This completes the "Step-by-Step Assembly" section. Check the unit over carefully at this time to be sure there are no poor solder connections, solder bridges, loose wire ends, solder splashes, etc. Then proceed to "Test and Adjustment."



PICTORIAL 9



Detail 9A

TEST AND ADJUSTMENT

The purpose of this section is to make sure your kit operates properly. If you do not get the proper results in the following steps, unplug the line cord plug and proceed to "In Case of Difficulty" on Page 19.

Refer to Pictorial 10 (Illustration Booklet, Page 3) for the following steps.

- () Position the circuit board and cabinet bottom as shown.
- () Place an insulator (piece of cardboard, etc.) under rocker switch SW1.

WARNING: In the following steps, do not touch the area marked "High-Voltage Area" in the Pictorial. High voltage is present here when the line cord is plugged into an outlet.

- () Position rocker switch SW1 so that the side nearest lamp D7 is up.
- () Plug in the line cord plug. Then position rocker switch SW1 so the side nearest lamp D7 is down. The lamp should light.

Use a voltmeter to perform the following steps.

- () Adjust your voltmeter to measure +15 volts DC. Then connect the common lead to either small wire socket labeled GND and the probe meter lead to the +12VDC small wire connector. Use short lengths of #22 solid wire or leads from 1/4-watt resistors. See the inset drawing.
- () Adjust control R6 until the voltmeter indicates +12 volts DC.
- () Connect the probe to the +5VDC small wire connector. The voltmeter should indicate +5 volts DC ± 0.1 volt.
- () Reverse the voltmeter polarity and measure the voltage at the -12 VDC small wire connector. The voltmeter should indicate -12 volts DC ± 0.12 volt.
- () Disconnect the voltmeter and set it aside.
- () Move rocker switch SW1 to its off position and disconnect the line cord plug.

This completes "Test and Adjustment." Proceed to "Final Assembly."

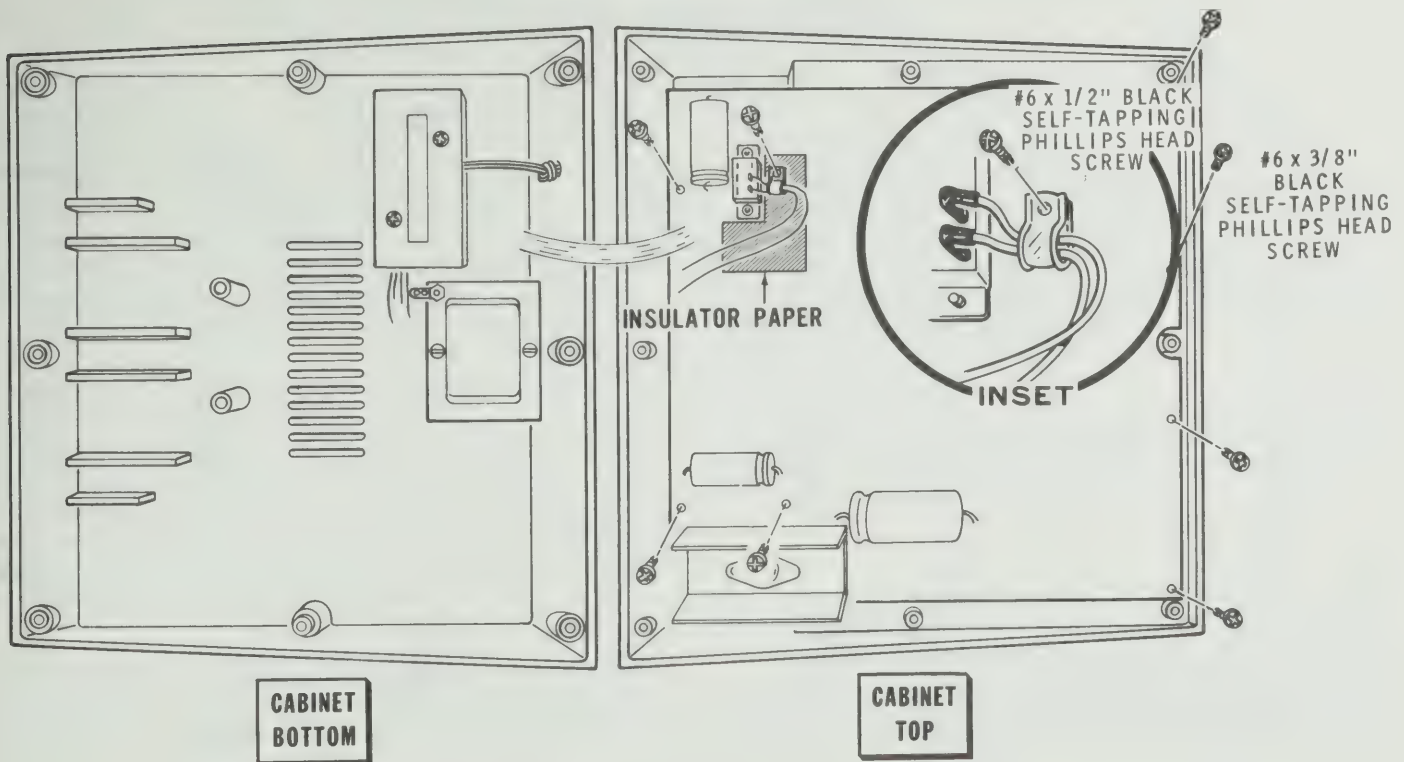
FINAL ASSEMBLY

Refer to Pictorial 10 (Illustration Booklet, Page 3) for the following steps.

- () Remove the backing paper from the Caution label and apply the label to the cabinet bottom as shown.
- () Remove the backing paper from the blue and white label and apply the label to the cabinet bottom as shown. Be sure to refer to the numbers on this label in any communication you have with the Heath Company about this kit.
- () Install a plastic foot at each of the four corners of the cabinet bottom in the smooth areas provided. First remove the backing paper; then press the foot into place.

Refer to Pictorial 11 for the following steps.

- () Remove the protective backing from the insulator paper and press the paper into position near switch SW1 as shown.
- () Refer to the inset drawing and mount a cable clamp to the two red wires coming from switch SW1. Secure the cable clamp and the circuit board to the cabinet top with a #6 × 1/2" black self-tapping phillips head screw and a #8 flat washer.
- () Position the circuit board in the cabinet top as shown and secure it with seven #6 × 3/8" black self-tapping phillips head screws.



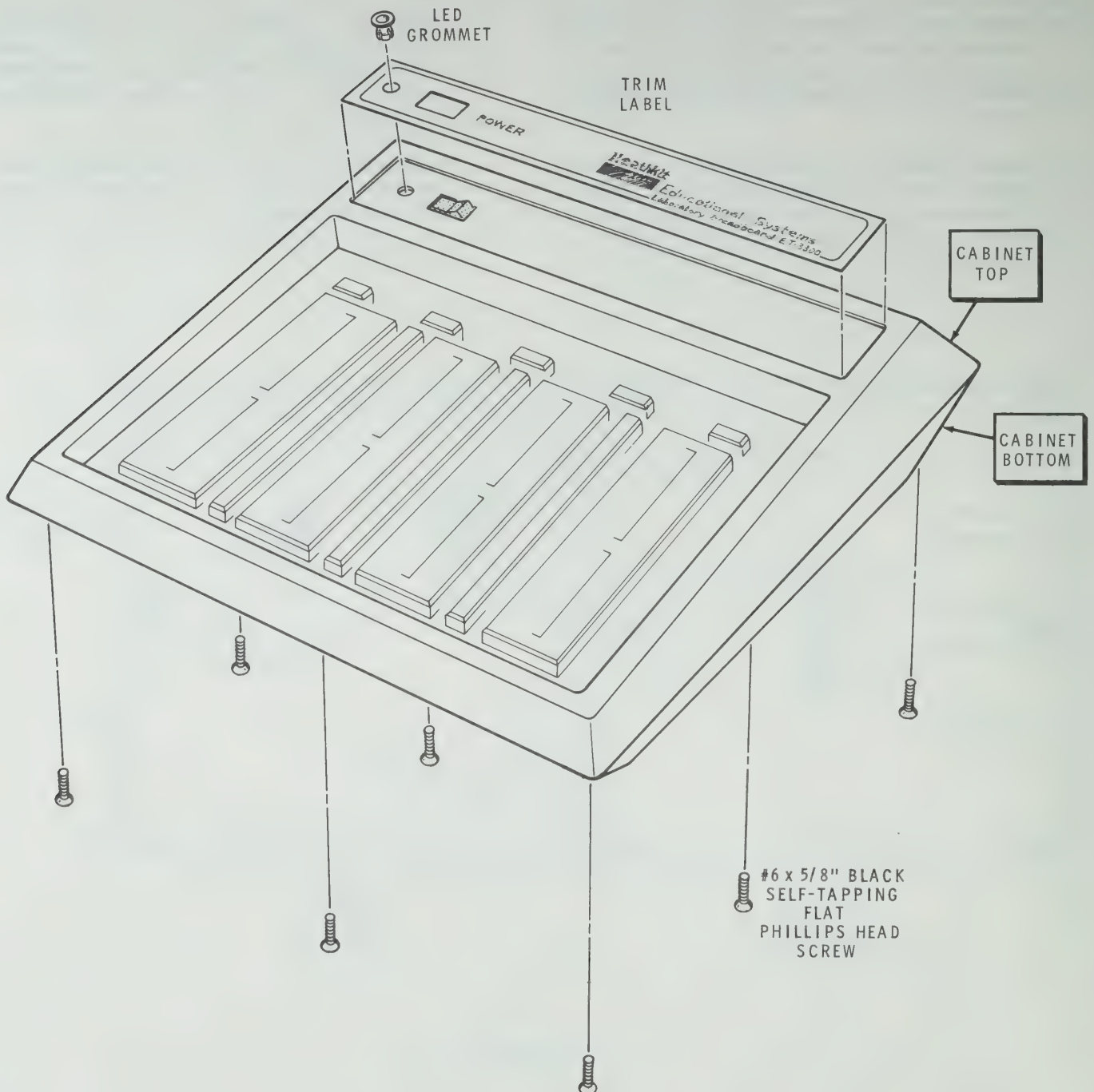
PICTORIAL 11

Refer to Pictorial 12 for the following steps.

- () Remove the paper backing from the trim label and apply the label to the cabinet top as shown.
- () Push the LED grommet into the indicated hole as shown.

- () Mount the cabinet top to the cabinet bottom. Use eight #6 × 5/8" black self-tapping flat phillips head screws. Do not use the two holes in the center of the cabinet bottom.

This completes the assembly of your kit. Use the remaining 3" lengths of #22 solid wire for your experiments. Proceed to "Operation."



PICTORIAL 12

OPERATION

The Laboratory Breadboard supplies +5 volts DC and ± 12 volts DC. It also provides a great number of connector sockets to allow extensive experimentation. Figure 1 (Illustration Booklet, Page 3) gives a brief description of the features.

WIRE SOCKETS

The wire sockets are designed to accept up to #20 (0.032") solid wire and most common component leads. Larger wires or leads will deform the socket connectors. Larger wire or lead sizes can be used if you "tack solder" a #22 wire to the larger wire or lead, and insert the #22 wire in the socket connector.

The four connectors in a small wire socket are internally connected together. Each horizontal row of five connectors in a breadboarding socket are connected together as shown in Figure 1. Also, each vertical row (36 holes) of connectors in a wire bus socket are connected together. These are normally used to connect power and ground to various points in your experimental circuits. The spacing between the two columns of connectors on each breadboarding socket is designed to accommodate any size dual-in-line integrated circuit package.

An IC puller is supplied with this kit. It will fit down into the center channel of the breadboarding socket to gently and easily lift an IC from the connectors.

CAUTION: Do not insert larger than #20 (0.032") solid wire or component leads in the connectors of this instrument.

IN CASE OF DIFFICULTY

This section of the manual is divided into two parts: "Visual Checks," and "Troubleshooting Chart." Use the "Visual Checks" first to find a difficulty that shows up right after your kit is assembled. You can also use the "Troubleshooting Charts" right after your kit is assembled, or at some future time in case your Laboratory Breadboard should ever malfunction.

If the trouble is still not located after you complete the "Visual Checks," check voltage readings against those shown in the "Schematic" on Page 22. Be sure you do not short any terminals to ground when making voltage measurements. If the probe should slip, for example, and short out a bias or supply point, it is very likely to damage one or more transistors or diodes. NOTE: All voltage readings were taken with a high impedance voltmeter (10 M Ω or greater).

In the extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of your Manual. Your Warranty is located inside the front cover.

VISUAL TESTS

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you consistently overlook.
2. About 90 percent of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Assembly Notes."
3. Check to be sure that all transistors and the IC are in their proper locations. Make sure each lead is connected to the proper point.
4. Check the values of the parts. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial diagrams. It would be easy, for example, to install a 2700 Ω (red-violet-red) resistor where a 27 k Ω (red-violet-orange) resistor should have been installed.
5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
6. A review of the "Circuit Description" may also help you determine the trouble.

Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE
Pilot lamp does not light.	<ol style="list-style-type: none"> 1. Fuse F1. 2. R1. 3. D7.
+12-volt power supply varies with Voltage Adjust control R6, but will not reach +12 volts DC.	<ol style="list-style-type: none"> 1. Zener diode ZD1.
Both plus and minus 12-volt supplies are high and will not adjust.	<ol style="list-style-type: none"> 1. Transistor Q4 open. 2. Transistor Q2 shorted. 3. Transistor Q1 shorted.
—12-volt supply high; +12-volt supply is OK.	<ol style="list-style-type: none"> 1. Transistor Q8 open. 2. Transistor Q6 shorted. 3. Transistor Q5 shorted.
No output from the +5-volt supply.	<ol style="list-style-type: none"> 1. Integrated circuit IC1 defective.

SPECIFICATIONS

Power Supplies

Output Voltages	+5 volts DC, $\pm 4\%$, at 1.5 A. +12 volts DC, adjustable, at 100 mA. -12 volts DC, $\pm 2\%$, at 100 mA.
Load Regulation	Less than 2% variation from no load to full load on 5-volt supply. Less than 2% variation from no load to full load on 12-volt supply.
Current Limiting	Fixed current limiting of each supply at rated current provides short-circuit protection.

Power Requirements 105-130 volt, 50/60 Hertz, 30 watt at full load.

Fuse Requirements 3/8-ampere slow-blow.

General

Dimensions 12" wide, 12" deep, 3.5" high. (30.5 cm wide, 30.5 cm deep, 8.9 cm high.)

Weight 4 lbs. (1.8 kgs.)

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic diagram (Illustration Booklet, Page 4) while you read this "Circuit Description."

+5-VOLT SUPPLY

The voltage from one of the secondary windings (green leads) of power transformer T1 is rectified by diodes D1 and D2, filtered by capacitor C1, and regulated by IC1 to produce the +5-volt DC supply.

± 12-VOLT SUPPLIES

The voltage from the other secondary winding (red leads) of power transformer T1 is rectified by diodes D3 through D6 and filtered by capacitors C2 and C6.

Transistor Q1 is a current amplifier for pass transistor Q2. If the current through Q2 becomes excessive, the voltage developed across R4 turns on transistor Q3. The current through R2, R3, and Q1 then has another path, through Q3. If Q3 conducts more, less current flows into the base of Q1 and Q2. This in turn allows less current to flow from the collector to the emitter of Q2 and the current is limited to a safe level.

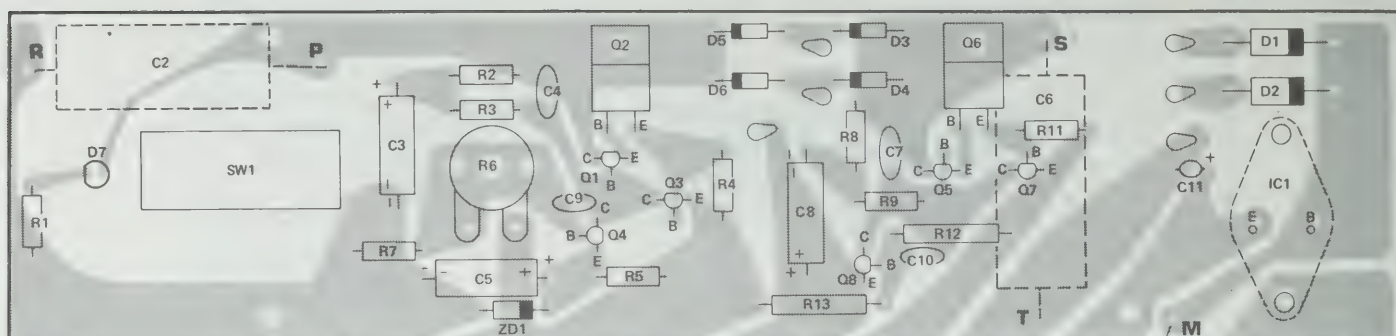
If the output voltage changes, this change is sensed by voltage divider R6 and R7 and is applied to Q4. Therefore, the base voltage of Q4 changes, but the emitter is held constant by zener diode ZD1. This causes the current through Q4 to change and again control Q1 and Q2 as before, until the output voltage is at the proper level.

The positive 12-volt supply is used as the reference for the negative 12-volt supply. Voltage divider R12 and R13 monitor the outputs of the supplies and control transistor Q8. The negative supply operates similar to the positive supply.

CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A. Find the circuit component number (R5, C2, etc.) on the X-Ray View.
- B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of the Manual.
- C. Adjacent to the "Circuit Component Number," you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



+12VDC
100MA

GND

-12VDC
100MA

+5VDC
1.5AMPS

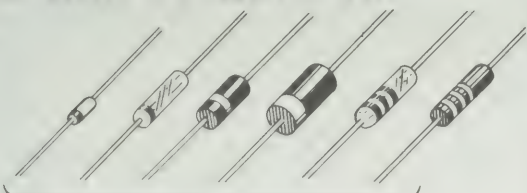
GND

C1

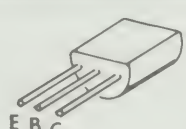
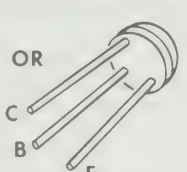
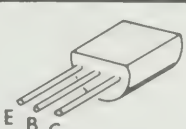
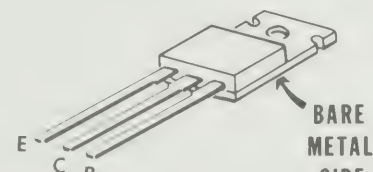
N

COMPONENT IDENTIFICATION CHARTS

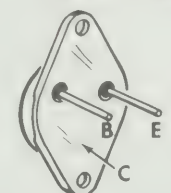
DIODES

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	BASE DIAGRAM
ZD1	56-97	1N3017	<p>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.</p>  <p style="text-align: center;">BANDED END</p>
D1,D2	57-42	3A1	
D3,D4,D5, D6	57-65	1N4002	

TRANSISTORS

Q5, Q7, Q8	417-235	2N4121	 <p>OR</p> 
Q1,Q3,Q4	417-801	MPSA20	
Q2	417-852	TIP31	 <p style="text-align: right;">BARE METAL SIDE</p>
Q6	417-872	TIP32	

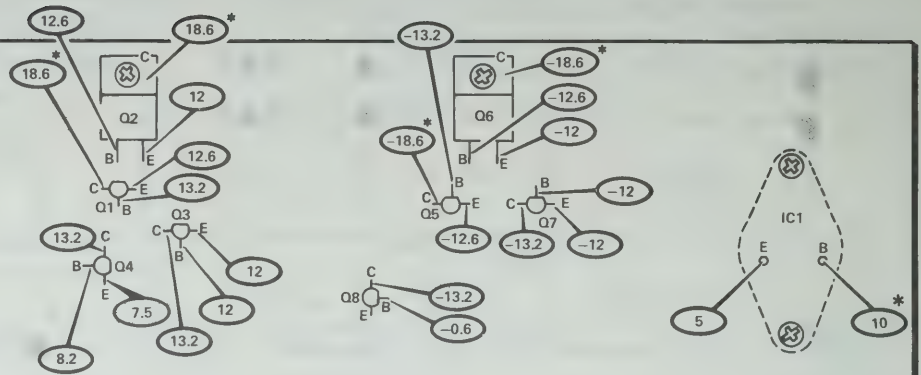
INTEGRATED CIRCUIT

IC1	442-30	309	
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LED

D7	412-640		
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CIRCUIT BOARD VOLTAGE CHART



CIRCUIT BOARD VOLTAGE CHART



CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.